

Atmospheric Rivers and the Need for Seasonal Outlooks

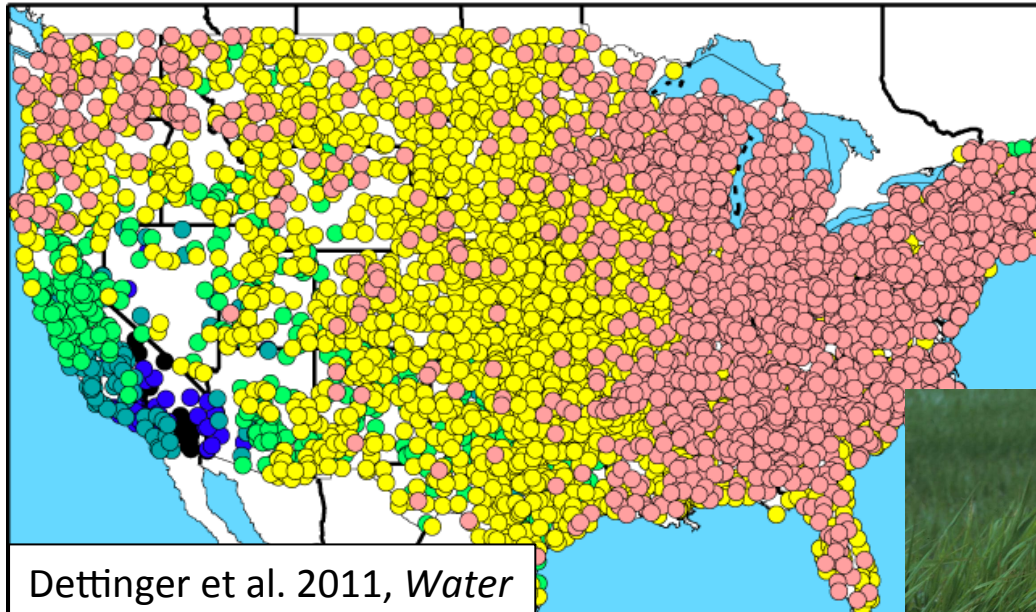
F.M. Ralph, DC May 2015



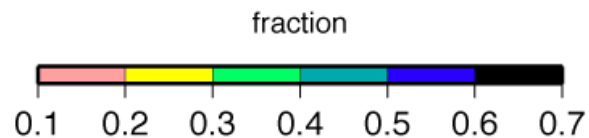
Center for Western Weather
and Water Extremes

SCRIPPS INSTITUTION OF OCEANOGRAPHY
AT UC SAN DIEGO

a) COEFFICIENTS OF VARIATION OF
TOTAL PRECIPITATION, WY 1951-2008

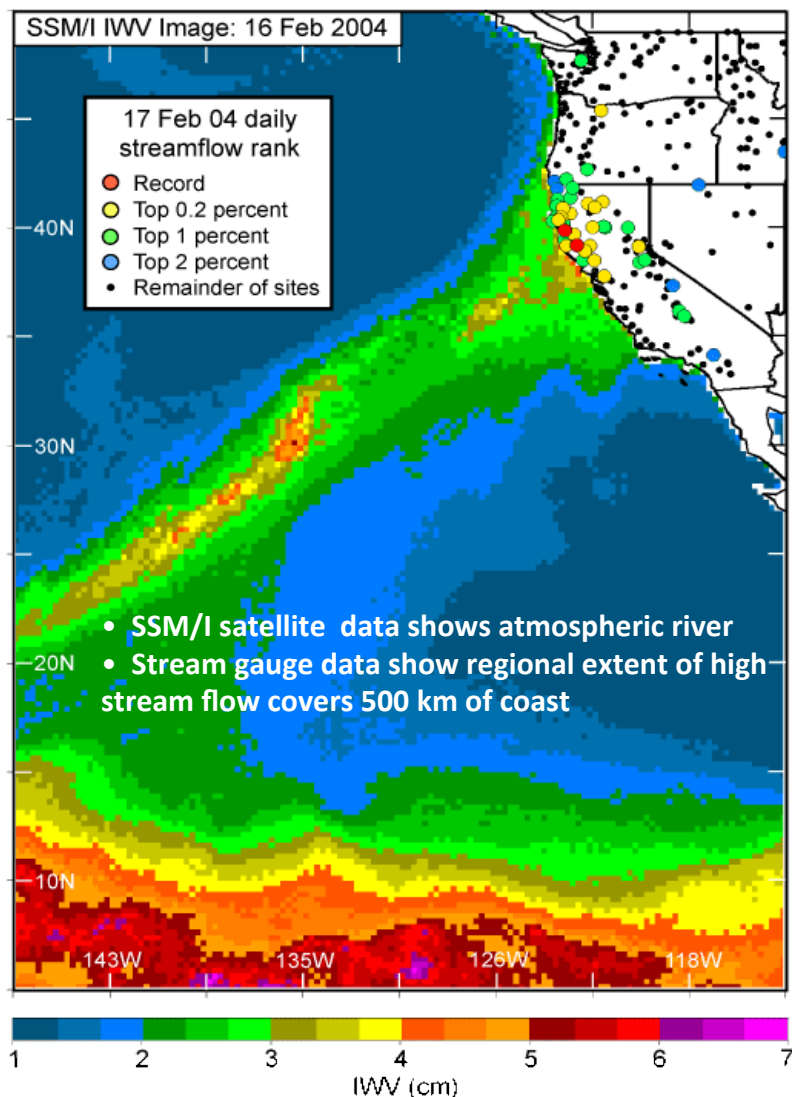


Dettinger et al. 2011, *Water*



**SOUTHWEST U.S.
PRECIPITATION IS
UNIQUELY
VARIABLE**





Flooding on California's Russian River: Role of Atmospheric Rivers

Ralph, F.M., P. J. Neiman, G. A. Wick, S. I. Gutman, M. D. Dettinger, D. R. Cayan, A. White, *Geophys. Res. Lett.*, 2006

Russian River floods are associated with atmospheric rivers: all 7 floods over 8 years.

Flooding in Western Washington: The Connection to Atmospheric Rivers

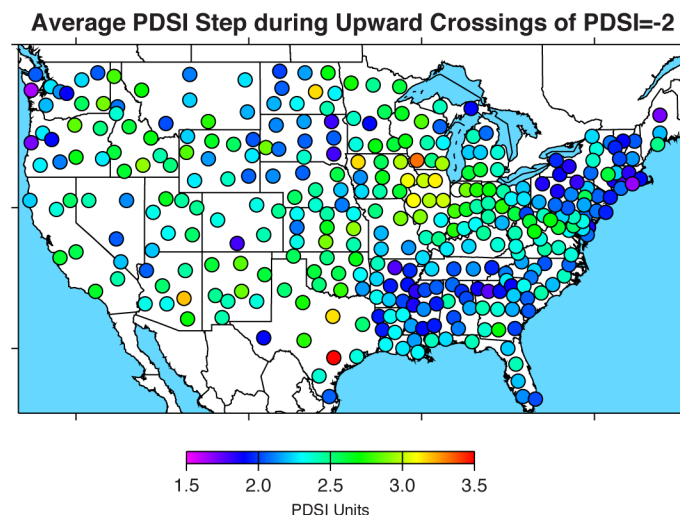
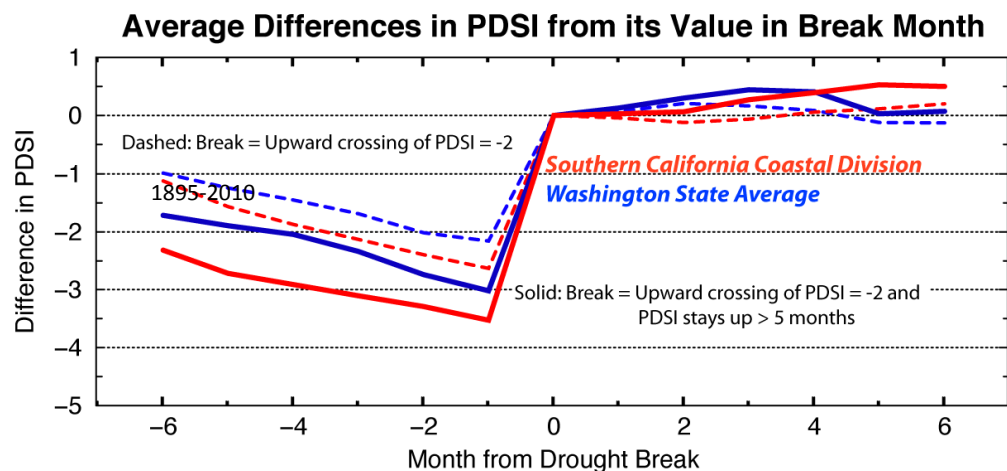
Paul J. Neiman, Lawrence J. Schick, F. Martin Ralph, Mimi Hughes, and Gary A. Wick, *J. Hydrometeorology* (2011)

Of 48 annual peak daily flows on 4 watersheds, 46 were associated with the land-fall of atmospheric river conditions.

Droughts, on average, end with a bang (and begin with a whimper) all over the U.S.

- **Atmospheric rivers provide the bang** in a large fraction of the west coast drought breaks, especially in winters

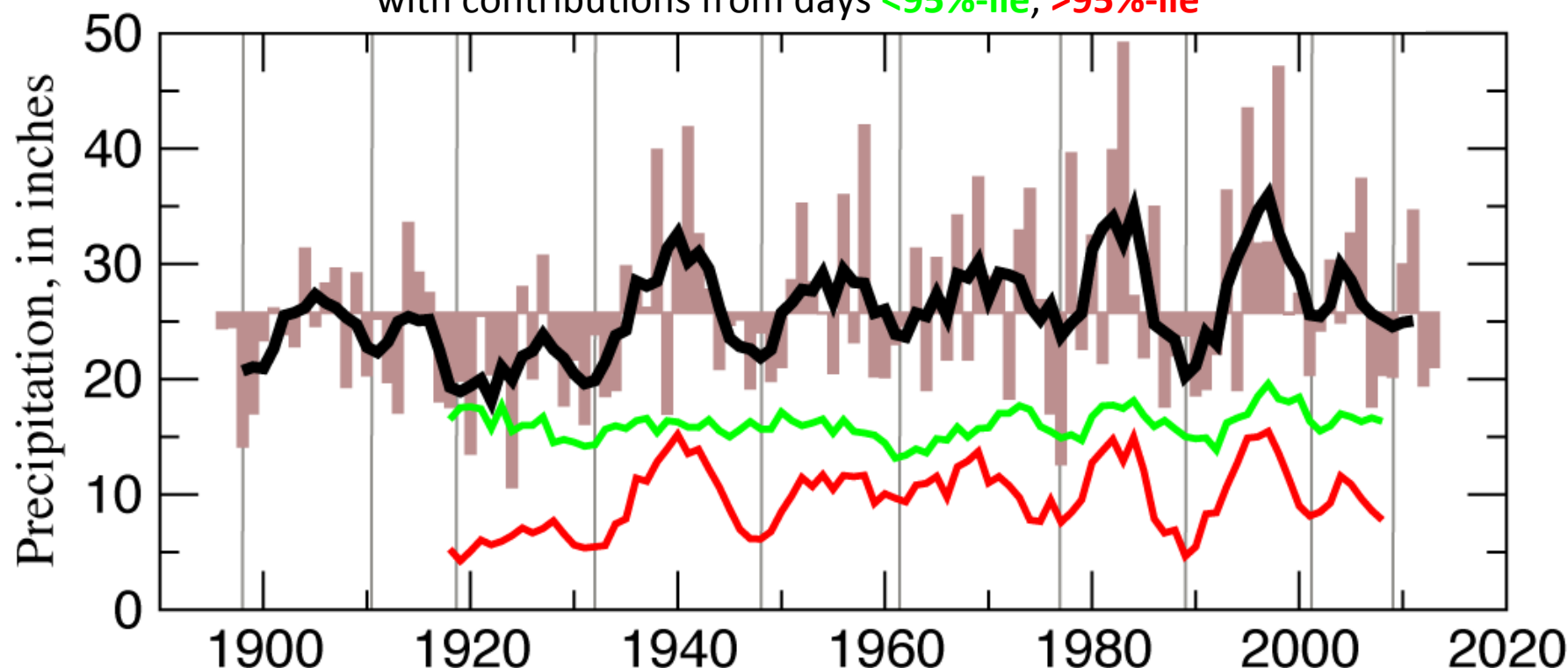
Dettinger, Michael D., 2013: Atmospheric Rivers as Drought Busters on the U.S. West Coast. *J. Hydrometeorol*, **14**, 1721–1732.



A few large storms (or their absence)

Account for a disproportionate amount of California's precipitation variability

Water year precipitation, Delta catchment
with contributions from days <95%-ile, >95%-ile



Dettinger and Cayan 2014, *San Francisco Estuary and Watershed Science*



Center for Western Weather
and Water Extremes

Atmospheric River CDR: Supporting AR Outlooks

Highlights

- Need a long history of AR events to explore relationship to MJO, AO, PNA,
- Water managers and public demand for info
- CA State legislative action: “Atmospheric River Research and Mitigation” bill
- CDR is a key NOAA response to CA water leadership request for help with drought

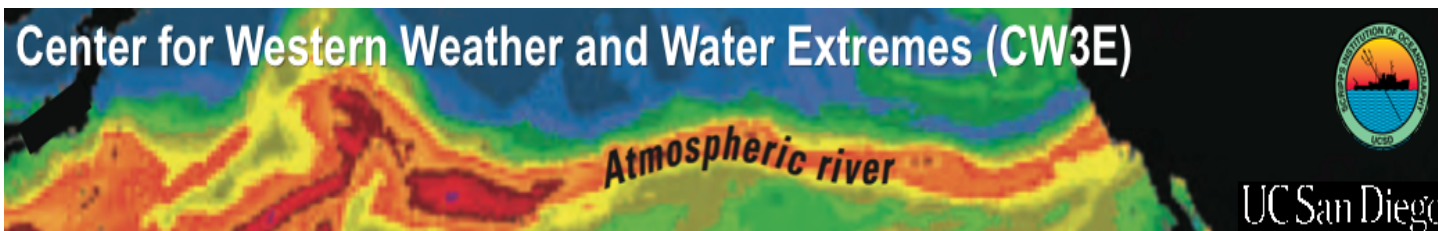
Atmospheric Rivers and the Need for Seasonal Outlooks

F. Martin Ralph, Ph.D.

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Director, Center for Western Weather and Water Extremes
(CW3E)

Washington DC

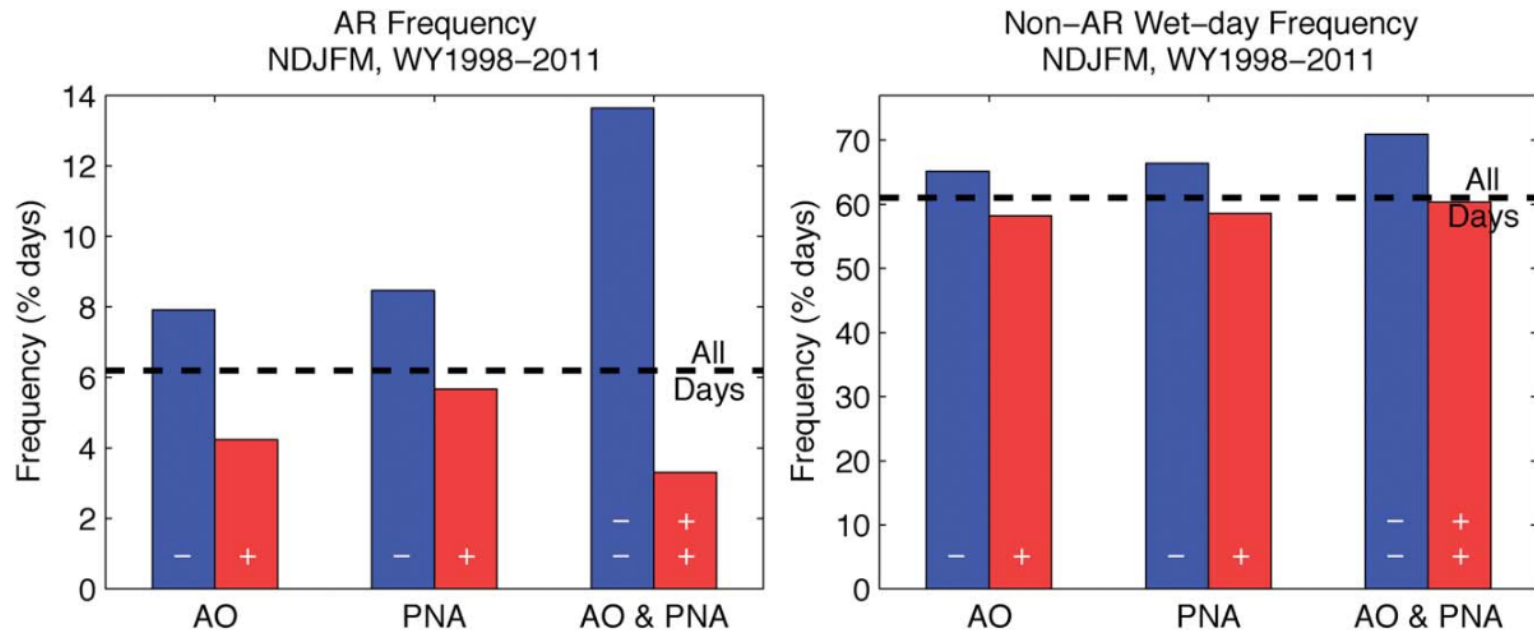
14 May, 2015



The 2010/2011 snow season in California's Sierra Nevada: Role of atmospheric rivers and modes of large-scale variability

Guan, B., N.P. Molotch, D. E. Waliser, E. Fetzer and P.J. Neiman
Water Resources Research (2013)

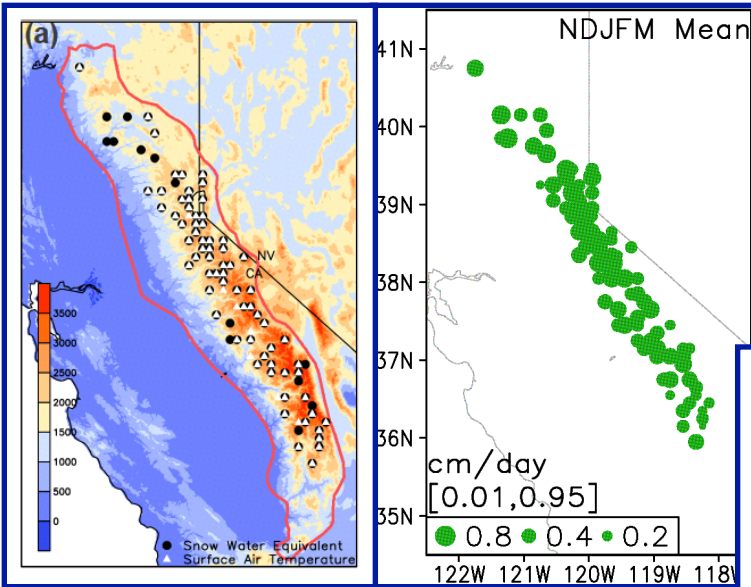
Arctic Oscillation (negative, i.e., southward cold-air outbreaks) combined with Pacific North American “teleconnections” pattern (negative, southern storm track)
Favors Atmospheric river conditions striking the Sierra and causing precipitation



Guan et al. (2012; Mon. Wea. Rev.)

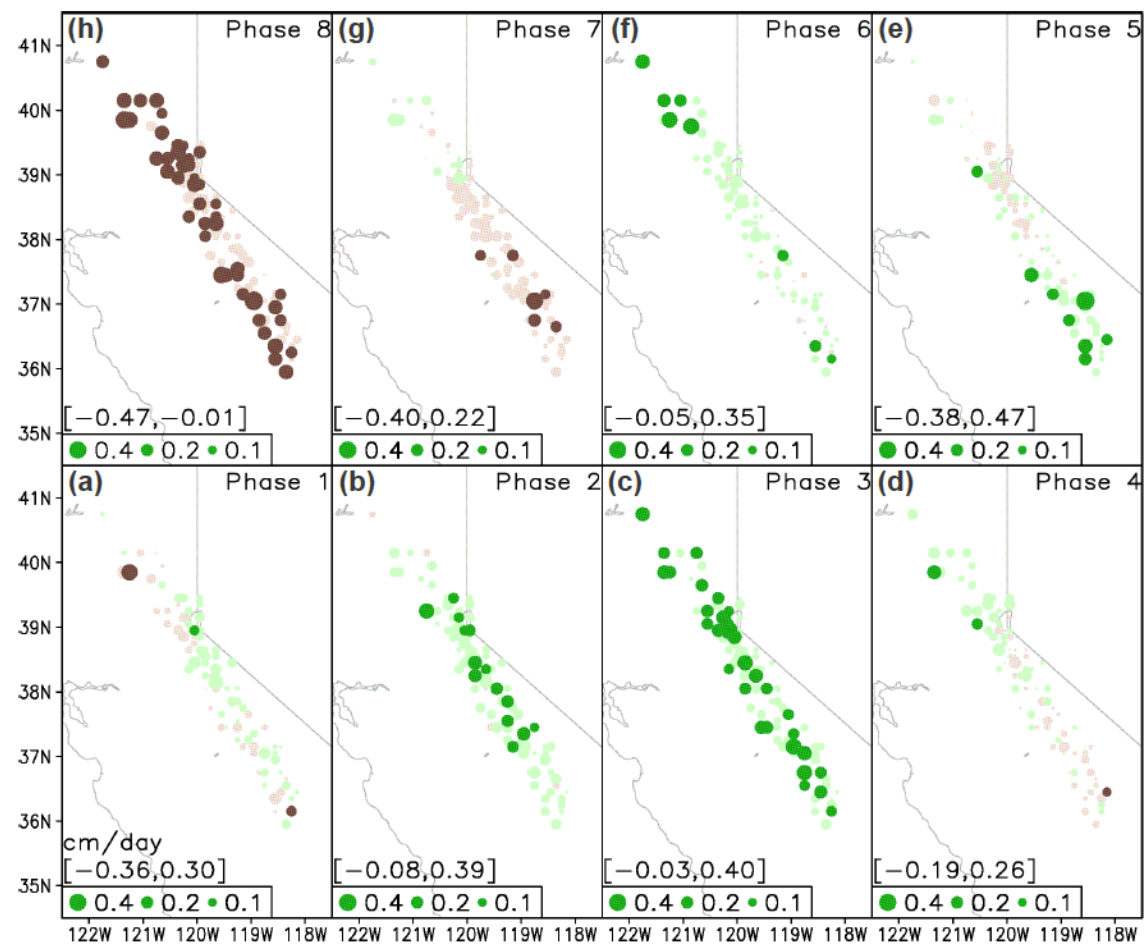
Snowpack in the Sierra acts as a natural and Important reservoir for CA.

Snowfall often comes in powerful winter storms.
40% of Sierra snow is from Atmospheric Rivers.



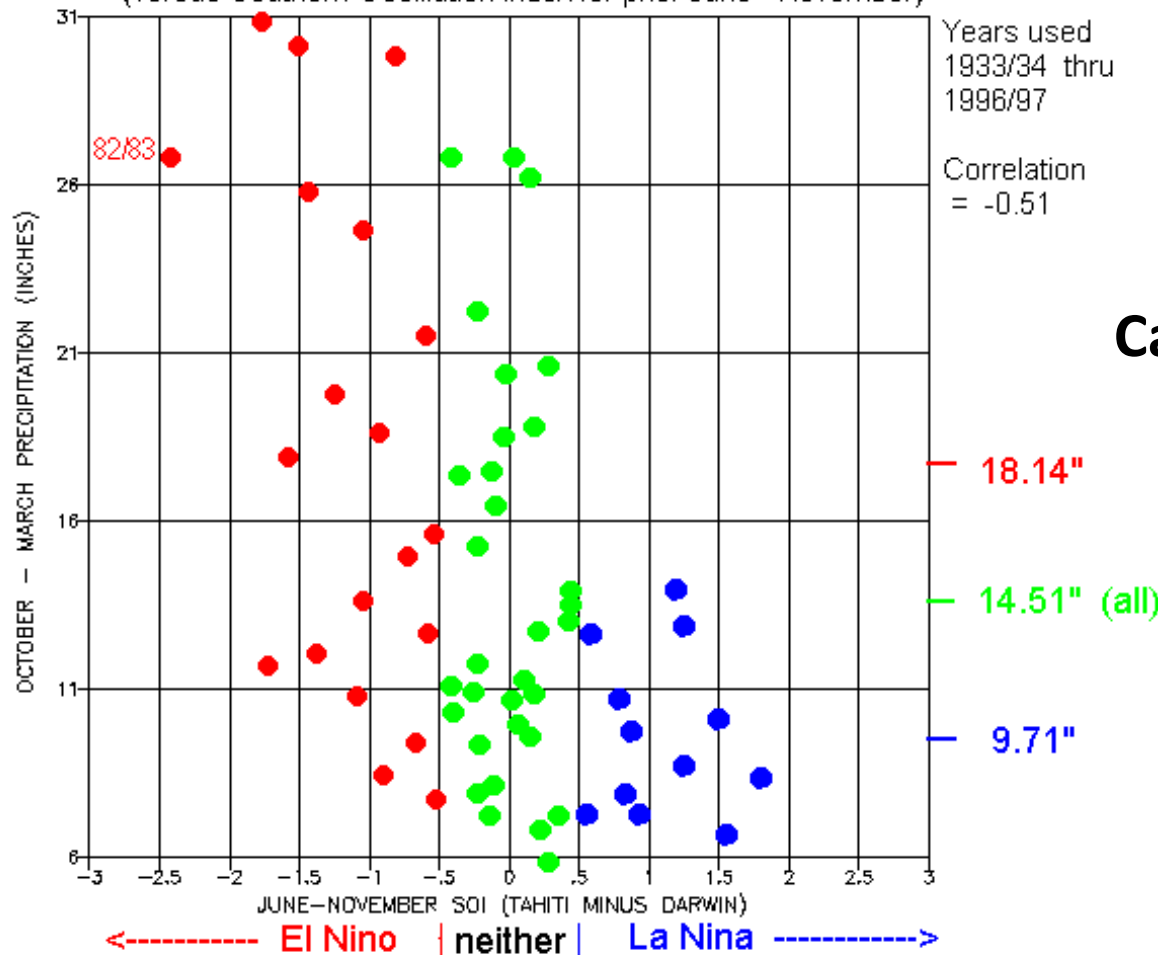
The MJO modulates snowfall .

- **Phase 3 -> + 30-50%**
- **Phase 8 -> - 30-50%**
- **MJO operates on a 30-60 day time scale. How predictable?**



South Coast California October thru March Precipitation

(versus Southern Oscillation Index for prior June - November)



WRCC

ENSO and Southern California Precipitation

Current drought conditions

NIDIS

U.S. Drought Monitor West

May 5, 2015
(Released Thursday May 7, 2015)
Valid 8 a.m. EDT

Statistics type: ☒ Traditional (D0-D4, D1-D4, etc.) ☐ Categorical (D0, D1, etc.)

Drought Condition (Percent Area):

Week	Date	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	2015-05-05	23.35	76.65	63.22	39.05	17.54	7.95
Last Week	2015-04-28	26.14	73.86	62.12	39.33	17.64	7.95
3 Months Ago	2015-02-03	30.68	69.32	52.74	31.35	18.51	6.96
Start of Calendar Year	2014-12-30	34.76	65.24	54.48	33.50	18.68	5.40
Start of Water Year	2014-09-30	31.48	68.52	55.57	35.65	19.95	8.90
One Year Ago	2014-05-06	30.20	69.80	61.47	45.60	19.60	4.69

Population Affected by Drought: **54,922,514**

[View More Statistics](#)

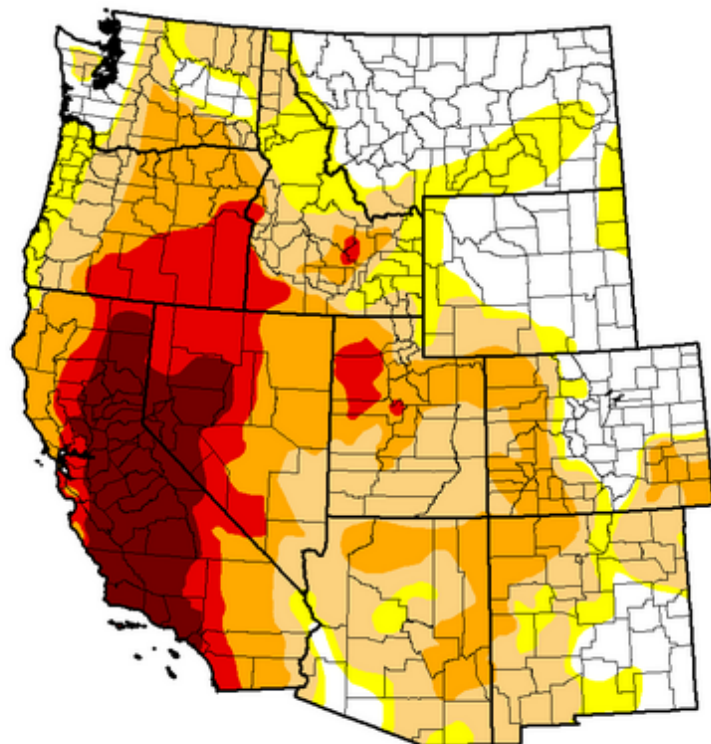
Intensity:

- D0 - Abnormally Dry
- D1 - Moderate Drought
- D2 - Severe Drought
- D3 - Extreme Drought
- D4 - Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying [text summary](#) for forecast statements.

Author(s):

Michael Brewer, NOAA/NCDC

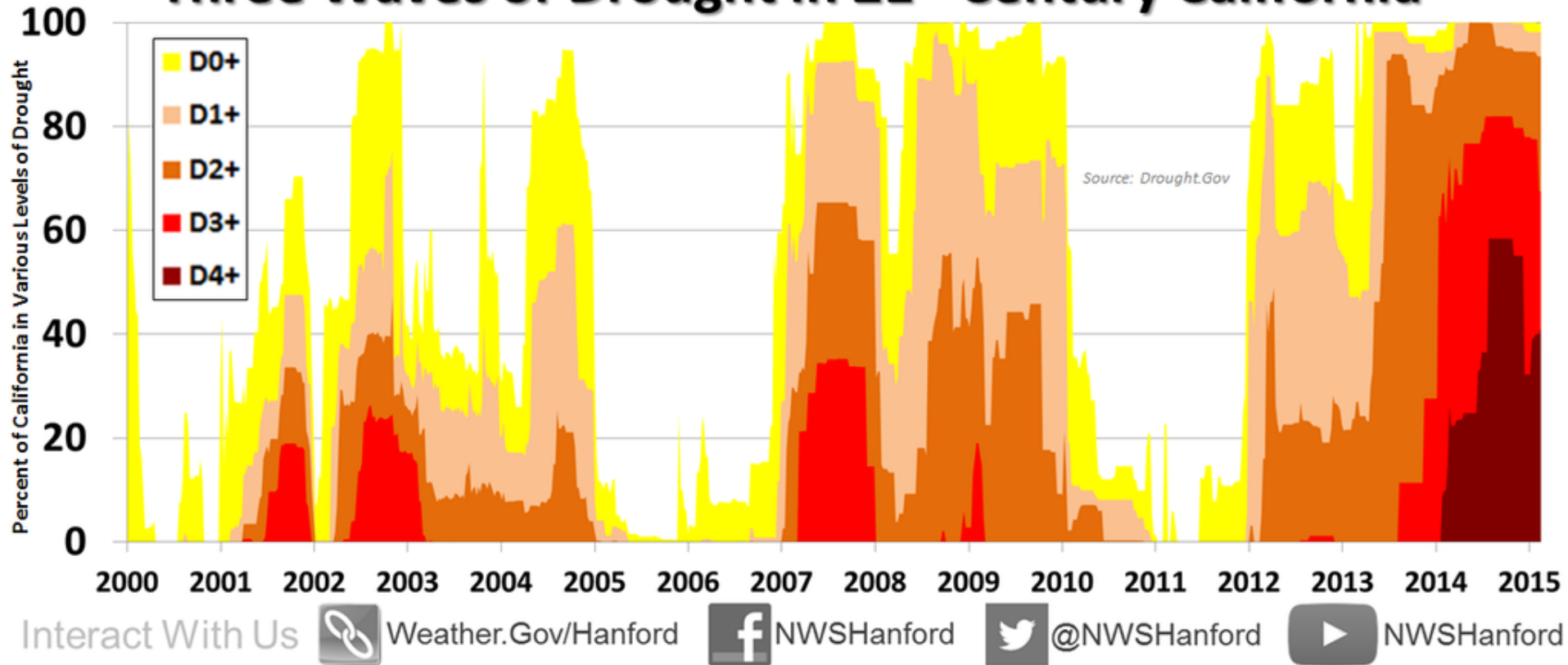


Download:



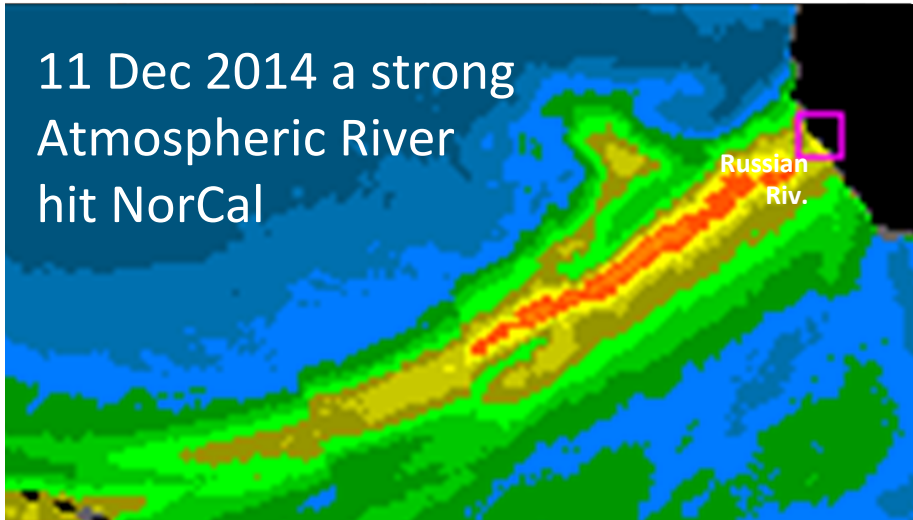
Drought in California since 2000

Three Waves of Drought in 21st Century California

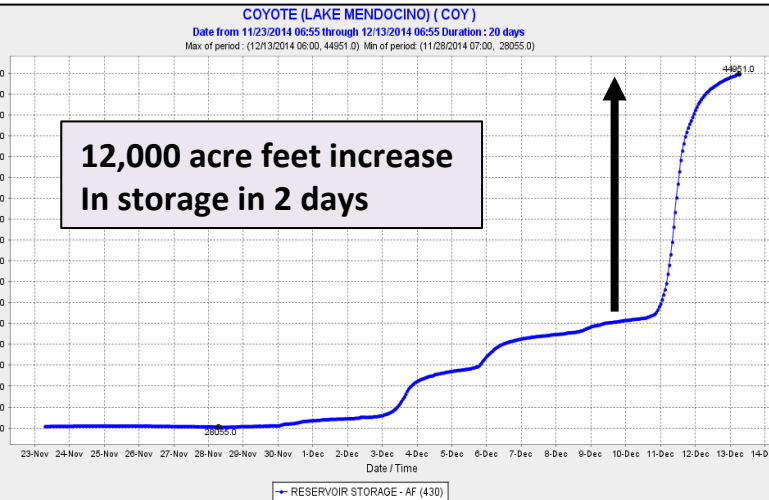
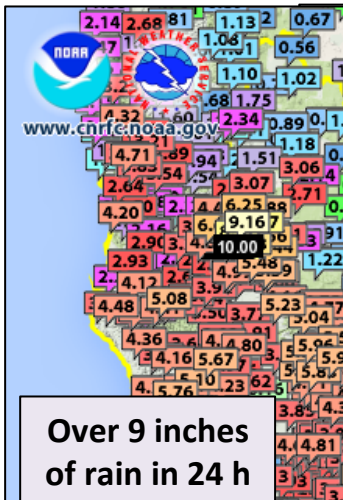


Courtesy NWS Hanford, CA WFO

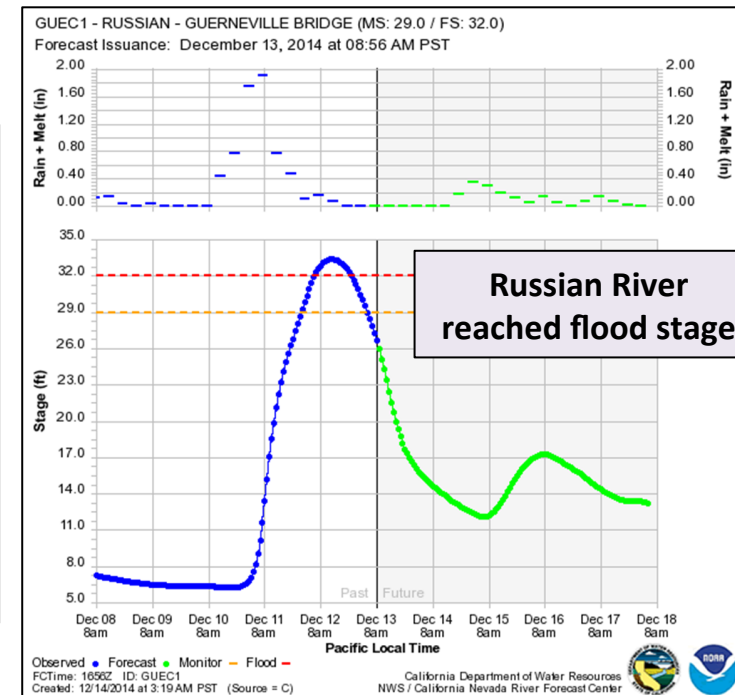
11 Dec 2014 a strong
Atmospheric River
hit NorCal



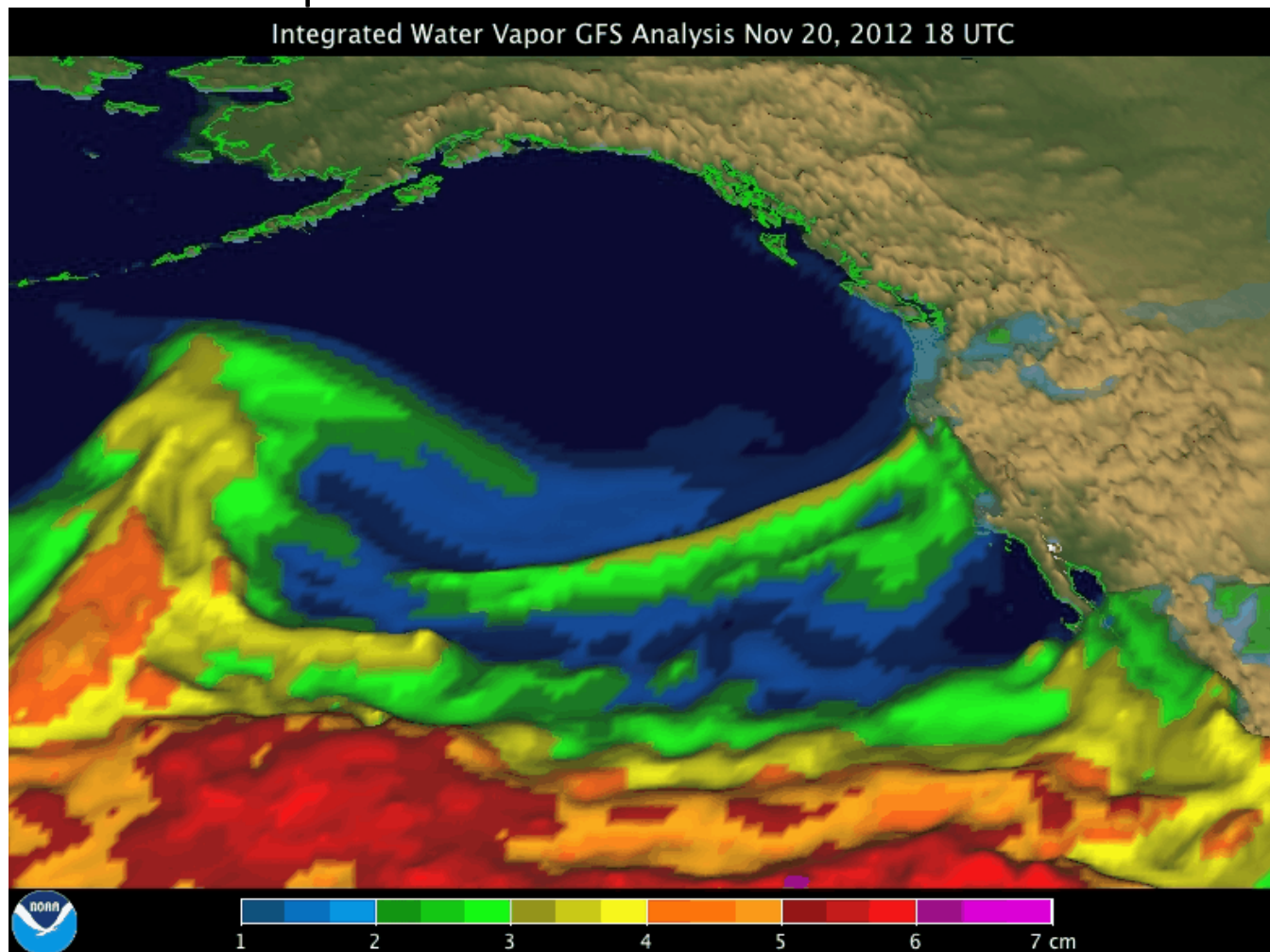
**Storm of 10-12 December 2014
Floods Can Happen During A
Drought**



(A more complete summary is available at cw3e.ucsd.edu)

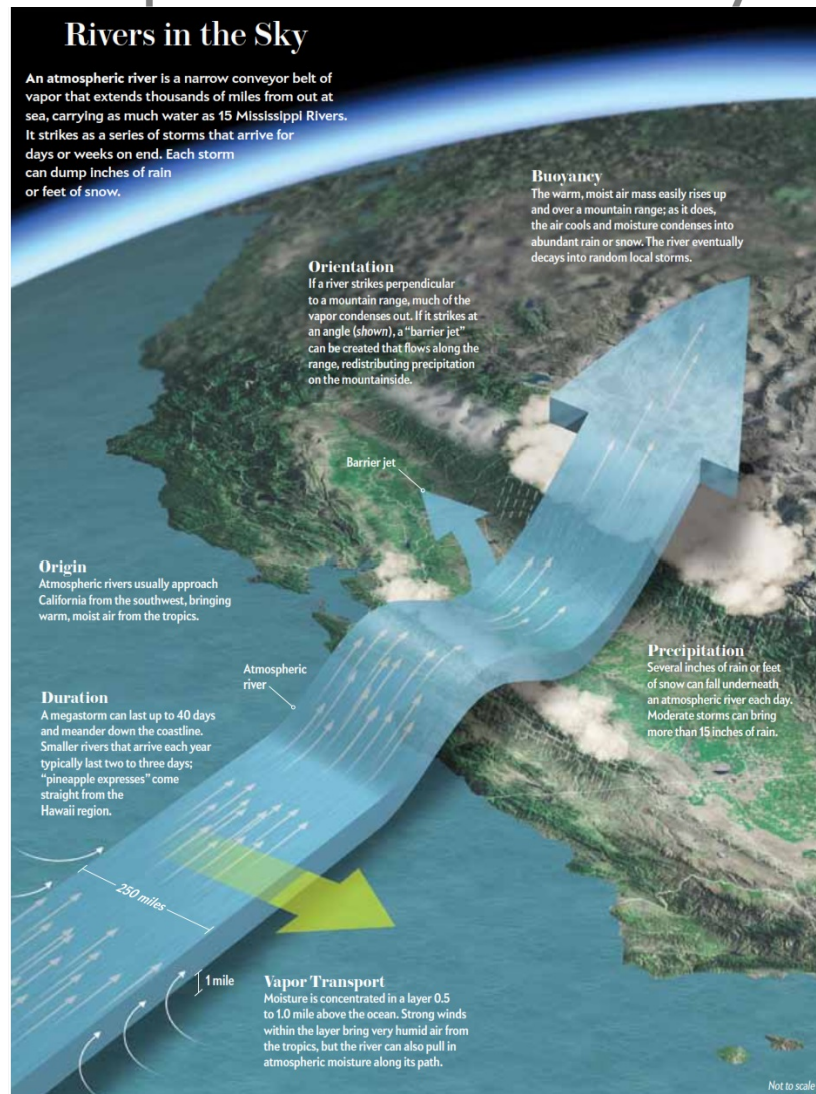


Atmospheric River Events 20 Nov-3 Dec 2012



Animation courtesy of Don Murray (NOAA/ESRL/PSD)

Atmospheric rivers – what are they?



A Major Result from 10-years of Research

Atmospheric rivers – what they are, how they work, and their crucial role in both water supply and flooding across much of the U.S. West Coast

Figure from an article in
Scientific American
by Dettinger and Ingram
(January 2013)

Region for which atmospheric river events are a dominant cause of extreme precipitation, flooding and contribute to water supply in the Western U.S. (Ralph et al. 2014)

